Commercial Crew Program

Status

NAC
Commercial Space Committee

Ed Mango

September 18, 2012
Commercial Crew Program Objectives

**Commercial LEO Capability**

- **Public Purpose**
  - Competed, funded SAAs to advance industry CTS capabilities

**ISS Design Reference Mission**

- **NASA Need**
  - NASA certification contracts
  - ISS services contract
CCiCap Overview
Summary of CCiCAP Portfolio

- Diversity of spacecraft types and launch vehicles
  - Two basic types of spacecraft
    - Capsules and lifting body
  - Two different launch vehicles
    - Falcon 9 and Atlas V

- The portfolio of companies maintains competition for future phases of the program which should produce “best value” for the government

- Significant progress planned for the base period with analysis, integrated design, development, and hardware testing

- Total set of milestones provide insight into the cost and schedule required to achieve a crewed demonstration flight to low Earth orbit
Sierra Nevada Corporation

**Descriptions & Features**

- Dream Chaser spacecraft is a reusable, piloted, lifting body, derived from NASA HL-20 concept
  - Carries up to 7 crew members
  - Utilizes non-toxic propellants
  - Primary Launch Site: Cape Canaveral, Florida
  - Primary Landing Site: Shuttle Landing Facility, Florida
  - Abort scenario leverages primary propulsion system with an ability to abort to a runway landing

- Atlas V vehicle launched from the Space Launch Complex 41 launch pad

**Base Period**

- $212.5M total NASA funding for 9 milestones
- Significant progress toward completion of critical design
- Two major safety reviews and significant subsystem technology maturation and hardware testing
Base Period Details (Key Milestones)

- Design and Development:
  - Program Implementation
  - Integrated System Baseline Review
  - Two Integrated System Safety Analysis
  - Certification Plan

- Testing:
  - Engineering Test Article Flight(s)
  - Wind Tunnel Risk Reduction
  - Spacecraft Subsystem Risk Reduction
  - Main Propulsion Risk Reduction
  - Reaction Control System Risk Reduction
Space Exploration Technologies Corporation (SpaceX)

- Descriptions & Features
  - Spacecraft uses a crewed version of the SpaceX Dragon capsule
    - Carries up to 7 crew members
    - Primary Launch Site: Cape Canaveral, Florida
    - Primary Landing Site: “On land” landing, specific landing site in work
    - Integrated, side-mounted launch abort system utilizing SuperDraco engines
  - Upgraded Falcon 9 vehicle launched from the Space Launch Complex 40 launch pad
  - Mid calendar year 2015 crewed test flight (dependent on funding and technical progress)

- Base Period
  - $440M total NASA funding for 14 milestones
  - Culminates in an integrated critical design review milestone
  - Includes a pad abort test and an in-flight abort test
Space Exploration Technologies Corporation (SpaceX)

- Base Period Details (Key Milestones)
  - Design and Development:
    - Integrated System Requirements Review
    - Ground Systems & Ascent Preliminary Design Review
    - Test Reviews for Pad Abort & In-Flight Abort
    - Human Certification Plan Review
    - On-Orbit & Entry Preliminary Design Review
    - Safety Review
    - Flight Review of Upgraded Falcon 9
    - Integrated Critical Design Review
  - Testing:
    - Dragon Primary Structure Qualification
  - Flight tests:
    - Pad Abort (SLC 40 and last quarter of 2013)
    - In-Flight Abort (SLC 40 and 2nd quarter of 2014)
The Boeing Company

- Descriptions & Features
  - CST-100 spacecraft is a reusable capsule design utilizing many proven flight components
    - Carries up to 7 crew members
    - Primary Launch Site: Cape Canaveral, Florida
    - Primary Landing Site: “On Land” landing, specific landing site in work
    - “Pusher” launch abort system
  - Atlas V launch vehicle using the dual engine Centaur upper stage configuration and launched from the Space Launch Complex 41 launch pad
  - Late calendar year 2016 crewed test flight (dependent on funding and technical progress)

- Base period
  - $460M total NASA funding for 19 milestones
  - Culminates in an integrated critical design review milestone
  - Significant propulsion system, avionics, and wind tunnel development and testing
The Boeing Company

- Base Period Details (Key Milestones)
  - Design and Development:
    - Integrated System Review
    - Production Design
    - Phase 1 Safety Review Board
    - Landing & Recovery/Ground Communication Design
    - Launch Vehicle Adapter Design
    - Certification Plan Review
    - SW Critical Design Review
    - System Critical Design Review
  - Testing:
    - Integrated Stack Force & Moment Wind Tunnel
    - Dual Engine Centaur Development
    - Orbital Maneuvering & Attitude Control Engine Development
    - Mission Control Center Interface Demonstration
    - Emergency Detection System Standalone
    - Avionics SW Integration Lab Multi-String Demonstration
    - Pilot-in-the-Loop Demonstration
Commercial Crew Program Objectives

Commercial LEO Capability

- Public Purpose
  - Competed, funded SAAs to advance industry CTS capabilities

ISS Design Reference Mission

- NASA Need
  - NASA certification contracts
  - ISS services contract
NASA/ISS Certification Overview
Presented at Program Forum in February 2012

<table>
<thead>
<tr>
<th>FY10</th>
<th>FY11</th>
<th>FY12</th>
<th>FY13</th>
<th>FY14</th>
<th>FY15</th>
<th>FY16</th>
<th>FY17</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCDev1 Element Design</td>
<td>Blue Origin</td>
<td>Boeing</td>
<td>Paragon</td>
<td>Sierra Nevada</td>
<td>ULA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCDev2 Element Design</td>
<td>Blue Origin</td>
<td>Boeing</td>
<td>Sierra Nevada</td>
<td>SpaceX</td>
<td>ATK</td>
<td>ULA</td>
<td>EAI</td>
</tr>
<tr>
<td>Integrated Capability iCap*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certification and Initial ISS Missions*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CCiCap** | Optional Milestones

---Notional---

**NASA Certification** | ISS Missions | Transition to Services

*Number of awards to conform to budget
Revised Acquisition Strategy (2012)

<table>
<thead>
<tr>
<th>FY12</th>
<th>FY13</th>
<th>FY14</th>
<th>FY15</th>
<th>FY16</th>
<th>FY17</th>
<th>FY18</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Commercial Crew Transportation System Development**

- **AFP**
- **Integrated Capability SAA (iCap)**
- **Optional Milestones**

**Certification for ISS Crew Transportation**

**Phase 1**
- Alignment with NASA certification requirements

**Phase 2**
- Verification, validation, test and final certification
- Certification to include at least one crewed ISS mission

**ISS Crew Transportation Services**

- **RFP**
- **ISS Services Contract**
Contract Objective - Begin early, critical certification work to meet NASA Crew Transportation System (CTS) requirements

- Maturing key certification products in Phase 1 enables industry readiness and level of maturity required for NASA evaluation of Phase 2
  - Allows technical interchanges between NASA and contractors on certification requirements
  - Alternate Standards
  - Hazard Analyses/Reports
  - Verification & Validation Plan
  - Certification Plan
- Begin the process of ISS visiting vehicle integration
- No design/development work funded through CPC
- Increases confidence in ISS services date
Phase 2 – Certification Contract

- Contract Objective – Enabling NASA to assess and approve the CTS capability to perform the NASA ISS DRM
- Completion of key products required for the NASA crewed mission to the ISS
  - Ensure NASA mission and safety objectives are achieved
  - Activities include:
    - Development
    - Test
    - Evaluation
    - Certification
  - Options may include a nominal number of crewed missions to the ISS following successful CTS Certification
  - Phase 2 activities will lead to a competitive acquisition for commercial ISS transportation services using a FAR-based fixed price contract
http://commercialcrew.nasa.gov